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NATURAL AND ARTIFICIAL INCUBATION OF  
HENS' EGGS.

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STUDY OF AN EGG.

In taking up the problems of incubation, a brief study of an egg will help us to understand the reasons for some of the rules for handling eggs during incubation. The shell of an egg is porous, consisting of an outer and an inner layer, under which are two membranes, separated at the large end of the egg, which form an air cell. This air space, which is about as large as a 10-cent piece in a fresh egg, increases in size directly in proportion to the evaporation in the egg. Under these membranes and surrounding the yolk is the white, or albumen, which contains 78.4 per cent of water, 20 per cent of protein, and 1.6 per cent of mineral matter. Two coiled membranous layers of dense albumen, called chalazæ, connect the opposite sides of the yolk with each end of the shell and tend to lessen its movement and regulate its position in the egg. The germ spot, or blastoderm, a semiopaque spot from one-eighth to one-sixteenth of an inch in diameter, is located on the upper surface of the yolk and always remains uppermost in the egg.

CARE OF EGGS FOR HATCHING.

Strong, fertile eggs are the prime essential in good hatching; these are obtained only from stock properly mated and kept under the best possible conditions to secure health and vigor. Eggs from over-fat breeding stock do not usually produce a large percentage of strong chicks. If breeders are confined, they should be fed a varied supply of grains, meat, and green feed. The green feed assists in keeping fowls in good breeding condition. Free range is usually an

NOTE.—Describes incubation, natural and artificial. Of interest to poultry raisers everywhere.

important factor in the production of hatchable eggs, as it is much easier to keep up the vitality of stock handled in this manner than in birds that are yarded. From 8 to 12 females of the American or general-purpose class and 12 to 15 of the Mediterranean class can be mated with one male, depending on his age and vitality and where the fowls are yarded, but this proportion may be increased where the birds have free range. Abundant ventilation in the house is also a great help in keeping the stock in good breeding condition.

Abnormal, small, and poorly shaped eggs should be discarded. Do not set eggs which have thin or very porous appearing shells. Eggs should be set when fresh, if possible, and it is not advisable to use eggs for hatching which are over two weeks old, although stale eggs will frequently hatch. Selecting uniformly large eggs for hatching, which are of the same color, is one of the quickest ways to secure uniformity in the offspring and increase the size of the eggs. Dirty eggs should be cleaned by rubbing lightly with a damp cloth, but care should be taken not to rub off any more of the natural bloom of the egg than is absolutely necessary. Duck eggs usually require washing, which does not appear to injure their hatching qualities. Eggs for hatching should be collected two or three times a day in freezing weather to prevent chilling. Broody hens allowed to sit on eggs in the laying nests all day may hurt the hatching qualities of the eggs. Eggs in large numbers are generally kept in a cabinet or turning rack, for convenience in handling, in a room where the temperature is between 50° and 60° F., if possible, although they will stand considerable variation. It is not necessary to turn eggs kept only for a few days, but it is advisable to turn eggs daily which are over a week old. Various commercial turning devices are sold by poultry supply companies, or the eggs may be kept in cabinet drawers and shuffled about with the hands by removing a few eggs from the trays. Commercial egg cases are sometimes used for holding the eggs for hatching.

Eggs from different varieties of the same class of poultry may be incubated together, but it is not advisable to mix eggs from the Mediterranean or egg breeds, such as Leghorns and Minorcas, with Plymouth Rocks or Orpingtons, as the eggs from the smaller breeds often hatch a little earlier than those from the larger breeds. Neither the hen nor the incubator will hatch strong chickens from weak germs or from eggs which have not received proper care.

#### METHODS OF PACKING HATCHING EGGS.

Eggs for hatching are shipped extensively over long distances successfully, but in many cases the shipment appears to affect the hatch. Setting eggs for shipment are packed in several different ways. One of the best methods is to use a common market basket well lined on

the bottom and sides with excelsior. After wrapping the eggs in a thin layer of paper and enough excelsior to make a ball of about 3 inches in diameter, pack them tightly in the basket, then put on a covering of excelsior, and over all sew a piece of strong cotton cloth, or the cloth can be pushed up under the outside rim of the basket with a case knife. The latter method of fastening the cloth is much quicker than the former and just as effective. Eggs are also shipped safely almost any distance by packing them in a stiff pasteboard carton or box made for this purpose, the space around the egg being filled with either chaff or bran. This package is then placed in a basket, the bottom and sides of which are lined with excelsior, and the spaces at either end of the box are packed with the same material. On top of this package is placed more excelsior and all is covered with cloth, as previously mentioned. Extra stiff cardboard cartons made to hold from one to several settings are used in which to ship eggs. These cartons or egg boxes are fitted with a handle for carrying, similar to that on a market basket. Bushel baskets are commonly used to ship orders of from 10 to 12 sittings of eggs, the manner of packing and covering being the same as mentioned in the first method. It is customary to rest eggs for hatching for about 12 hours after they are received to allow the germ to regain its normal position before the eggs are placed in the incubator.

### PERIOD OF INCUBATION.

The period of incubation varies with different species of poultry, as shown in the accompanying table:

*Period of incubation.*

Kind of poultry.	Days.	Kind of poultry.	Days.
Hen.....	21	Peafowl.....	28
Pheasant.....	22-24	Guinea.....	26-28
Duck.....	28	Ostrich.....	42
Duck (Muscovy).....	33-35	Goose.....	30-34
Turkey.....	28		

The period of incubation varies somewhat with conditions, so that a hatch may run one or two days over in some cases, due to an accident during incubation or to a low temperature throughout that period, while, on the other hand, it may come off earlier. If through any accident the eggs are chilled or overheated, it is advisable to continue the hatch, testing the eggs after a few days to determine the extent of the damage. Chickens have been hatched from eggs left out of the incubator all night, as well as from eggs which have been subjected to a temperature of over 110° F. for a short time.

### TIME OF THE YEAR TO HATCH CHICKENS.

February, March, and April are the best months to hatch chickens, depending somewhat upon the individual, as well as the climatic conditions. Chickens are hard to raise either in cold, wet, or hot weather, and should not be hatched later than May 15 in the latitude of Washington if the pullets are desired for fall egg production, while an earlier date should complete the time of hatching farther south. The smaller breeds can be hatched later than those which are larger and slower to develop, as they mature about a month earlier.

### NATURAL INCUBATION.

System and care in the management of sitting hens will produce a large number of chickens at a comparatively small expense. Even with the best of care, some hens prove to be fickle mothers and cause trouble and loss in hatching by breaking their eggs, leaving their nests, or trampling on the chickens when first hatched. Most hens of the general-purpose breeds, such as the Plymouth Rocks, Wyandottes, Rhode Island Reds, and Orpingtons, make very good mothers. The heavier class, or meat breeds, including the Brahmas and Cochins, make good sitters, but are inclined to be clumsy on the nest. The Leghorns and other Mediterranean breeds are very nervous, and usually do not make good mothers.

Where only a few hens are set, special quarters are not necessary (see fig. 1), but where many are used a separate room should be provided for the sitters. Portable nests are frequently furnished for the laying hens, so that broody hens can be moved in them to new quarters. Of the various styles of nests used for sitting hens, the following has given good satisfaction: 15 inches square, 15 inches high, with a board 6 inches high in front to prevent nesting material from falling out. The nests may be arranged in tiers, with a hinged front, which makes a platform for each tier when open. A large number of hens may be set in this way in a moderate-sized room. When using a bank of nests, such as that which has just been described, it would be well to place 3 or 4 inches of damp earth in the bottom of each nest. The nesting material is next put in, and may consist of hay, chaff, or straw. Pack this material down firmly, and shape a circular nest out of it, which should be slightly deeper in the center than at the edges, as a nest so shaped will prevent the eggs from rolling out from under the hen and becoming chilled.

### HOW TO SET A HEN.

As the time approaches for the hen to become broody or sit, if care is taken to look into the nest, it will be seen that there are a

few soft, downy feathers being left there by the hen; also the hen stays longer on the nest when laying at this time, and on being approached will quite likely remain on the nest, making a clucking noise, ruffling her feathers, and pecking at the intruder. When it is noted that a hen sits on the nest from two to three nights in succession, and that most of the feathers are gone from her breast, which should feel hot to the hand, she is ready to be transferred to a nest which has been prepared for her beforehand. The normal temperature of a hen is from  $106^{\circ}$  to  $107^{\circ}$  F., which varies slightly during incubation. Dust the hen thoroughly with insect powder, and in applying the powder hold the hen by the feet, the head down, working the powder well into the feathers, giving special attention to regions around the vent and under the wings. The powder should

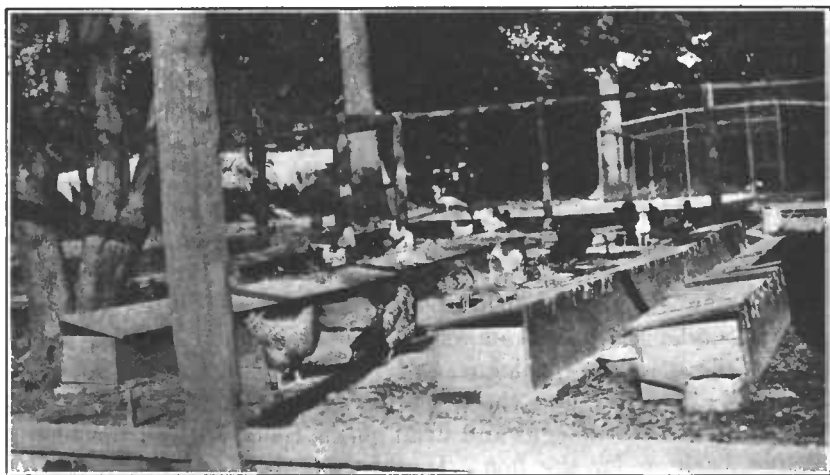


FIG. 1.—Outside nests for sitting hens. The hens are fastened to stakes by strings tied around their legs.

also be sprinkled in the nest. The nest should be in some quiet, out-of-the-way place, where the sitting hen will not be disturbed. Move her from the regular laying nest at night and handle her carefully in doing so. Put a china egg or two in the nest where she is to sit, and place a board over the opening so that she can not get off. Toward the evening of the second day quietly go in where she is sitting, leave some feed and water, remove the board from the front or top of the nest, and let the hen come off when she is ready. Should she return to the nest after feeding, remove the china egg or eggs and put under those that are to be incubated. If the nests are slightly darkened the hens are less likely to become restless. At hatching time they should be confined and not be disturbed until the hatch is completed, unless they become restless, when it may be best

to remove the chicks that are hatched first. In cool weather it is best not to put more than 10 eggs under a hen, while later in the spring one can put 12 to 15, according to the size of the hen.

#### CARE OF THE SITTING HEN.

If several hens are sitting in the same room, see that they are kept on the nests, only allowing them to come off once a day to receive feed and water, the feed to consist of corn, wheat, or both. If there are any that do not desire to come off themselves, they should be taken off. Hens usually return to their nests before there is any danger of the eggs chilling, but if they do not go back in half an hour in ordinary weather, they should be put on the nest. Where a large number of sitters are kept in one room it is advisable to let them off in groups of from 4 to 6 at a time. The eggs and nests should be examined and cleaned, removing all broken eggs and washing those that are soiled; in the latter case the soiled nesting material should be removed and clean straw added. Nests containing broken eggs that the hen is allowed to sit on soon become infested with mites and lice, which cause the hens to become uneasy and leave the nest, often causing the loss of valuable sittings of eggs. In mite-infested nests, the hen, if fastened in, will often be found standing over rather than sitting on the eggs. Many eggs that are laid in the late winter and early spring are infertile. For this reason it is advisable to set several hens at the same time. After the eggs have been under the hens from 5 to 7 days, the time depending somewhat on the color and thickness of the shells—white-shelled eggs being easier to test than those having brown shells—they should be tested,<sup>1</sup> the infertile eggs and dead germs removed, and the fertile eggs put back under the hen. In this way it is often possible to put all the eggs that several hens originally started to sit on under fewer hens and reset the others. For example, 30 eggs are set under 3 hens at the same time, 10 under each. At the end of 7 days we find on testing the eggs from all the hens that 10 are infertile, which leaves us 20 eggs to reset, which we do by putting them under 2 hens, and have the remaining hen sit over again after she has sat only 7 days. In this way considerable time can be saved in one's hatching operations.

#### TYPES OF INCUBATORS.

There are many different types of incubators on the market, all of which are of one of the following types: Hot air, hot water, or mammoth machines. Both "moisture" and "nonmoisture" incubators are made in the different styles of hot-air and hot-water ma-

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<sup>1</sup> See p. 14 for directions for making tests.

chines. The small machines are heated either by burning kerosene oil or gas, while the heat for most of the mammoth machines is supplied by a coal stove, although gas is also used to some extent. Gas burners require much less attention than oil heaters, but a supply of gas is not available in many localities where oil may be purchased. Electricity is also used for heating, both in small incubators and in mammoth machines.

#### **HOT-AIR AND HOT-WATER MACHINES.**

Hot-air and hot-water incubators are used successfully throughout the country. The water in the tanks of the hot-water machines should be emptied after the last hatch, which also prevents freezing when stored in a cold climate. The hot-water incubator will hold its heat longer than the hot-air machine, in case the lamp should go out; but the possibility of such an accident is too slight to be worth considering where the incubator receives proper attention.

#### **MAMMOTH INCUBATORS.**

The mammoth machines are used extensively both in the day-old chick business and in custom hatching. Their capacity runs from 1,500 to 10,000 or more eggs, as the machines are built in sections of about 2,000 eggs each, the size varying in different makes. When an incubating capacity of less than 3,000 to 4,000 eggs is desired, individual incubators of 50 to 400 egg capacity are generally used.

#### **THERMOSTAT.**

The part of the equipment of the incubator which controls the regulation of the heat is called the thermostat. Thermostats depend on the principle of expansion and contraction caused by changes in temperature. They are fastened in the egg chamber and connected by a free rod to a bar, on the end of which hangs the damper. Some thermostats regulate the size of the flame as well as the position of the damper. Regulation of the temperature of the incubator depends directly on the efficiency of this instrument, so that it is necessary to have one of a reliable make. Bar thermostats are made of a combination of metals, such as steel, zinc, and aluminum. The wafer or disk thermostats, which contain some fluid used for expanding and contracting the disk, are also used, their efficiency depending entirely upon the material used in their construction.

#### **THE THERMOMETER.**

There are two styles of incubator thermometers, with various modifications; one is placed on the egg tray, while the other is hung directly above the eggs. The thermometer should be used according



to the manufacturer's rules, unless there is a very good reason for making a change. Where the thermometer is placed on the tray, or is laid on the eggs, some operators prefer to have the bulb come in contact with two eggs, so that it may record the temperature of at least one fertile egg. It is advisable to test the thermometers once a year with a clinical thermometer, which may be secured from a physician or at a drug store. This can be done by putting both thermometers in warm water, heated at about 103° F., which should be kept stirred, taking care to keep the bulbs near each other and at the same level in the water; if correct, the incubator thermometer will register the same as the clinical thermometer. The position of the thermometer in the egg chamber affects the proper temperature at which to operate the machine, as a difference of an inch in height in some egg chambers will mean at least a degree of difference in temperature. The thermometer is usually placed in the front of the egg tray, so that it can be easily read.

#### SELECTION OF AN INCUBATOR.

There are a large number of reliable makes of incubators manufactured in this country, so that we can not recommend any particular machine. Some machines have become popular in certain sections of the country, because they were advertised extensively in that section rather than on account of special adaptability to the climatic conditions. Cheap machines are less reliable, require more attention, and wear out much quicker than higher-priced incubators. As the value of the machines is small compared with the value of the eggs used during the normal life of an incubator, it is poor economy to purchase a machine which is not reliable. Whenever possible it is well to select an incubator which is giving good satisfaction in your vicinity, so that you may get the benefit of the experience of other operators in your section.

The details of construction and equipment of most incubators are so subject to change that it is impossible to state definitely the best kind of lamps, brackets, regulators, and other equipment for the different incubators. The lamp should have a bowl large enough to hold sufficient oil to burn at least 36 hours under average weather conditions; it should be easy to remove and replace, and set absolutely tight in position. The incubator should be set so that the lamp is at a convenient height and the egg tray convenient to handle.

#### NUMBER OF INCUBATORS.

The best size of an incubator to buy depends upon circumstances. It takes about as much time to care for a 60 as it does for a 360 egg machine, so that it is generally advisable to get one of at least 150-

egg capacity, although special conditions often exist which make smaller machines valuable. A small machine is often used in connection with a larger one, placing all the eggs in the large machine after the first or second test. Incubators of from 300 to 400 egg capacity are generally used on those large farms which use individual lamp incubators. Many poultrymen believe that it pays to have an incubator capacity large enough to hatch the bulk of their stock in two or three batches, so that much time is saved in tending to the incubators and brooders, while the chickens are more even in size than those that are hatched when the incubating period extends over a longer time. A fair estimate for a poultry farm is an incubator space of one-egg capacity per hen, provided that about one-half of the flock is to be renewed yearly and no outside hatching is carried on. The larger machines cost less in proportion to their capacity than the smaller ones.

#### INCUBATOR CELLAR OR HOUSE.

Incubators are operated in a great variety of places with success. Where only a few small machines are used they are generally run in a room or the cellar of the house. A special cellar or incubator house should be provided where the incubator equipment is extensive or where mammoth machines are used. The main essentials are to have a room which is not subject to great variations in temperature and which is well ventilated so that the air is fresh and sweet. If built above ground the walls should be double and the entire building well insulated. Good results in hatching are secured in incubator cellars and in incubator rooms which are entirely above the ground level, but the former place is more commonly used. Incubators may be operated in buildings with single walls, especially in sections which have a mild climate, but a well-insulated room is preferable.

The incubator room or cellar should be large enough to allow the attendant to work around the machines conveniently. Many incubator cellars are provided with some system of ventilation in addition to the windows, while in others the ventilation is controlled entirely by the latter method. The essential features are to keep the air in the room fresh and sweet. Muslin screens on the windows provide good ventilation without draft and at the same time keep the sun from shining on the machines. Many incubator cellars have cement floors, which are easier to keep clean and neat than dirt floors. (See fig. 2.)

#### SETTING UP AND OPERATING THE INCUBATOR.

Set up the incubator according to the manufacturer's directions, and see that the machine is perfectly level. If a spirit level is not available, a long shallow pan of water set on top of the incubator

can be used as a level to assist in setting up the machine. Be sure that all parts of the incubator are in their proper positions and that the regulator works freely. Do not plane off the door of the incubator, if it sticks, until the machine has been heated up and thoroughly dried. Run the machine at about 102° F. for a day before putting in the eggs. It takes several hours for the machine to come back to its correct temperature after the eggs are first put in; therefore the regulator should not be touched during that time. See to the regulation of the temperature of the incubator before opening the door of the machine to attend to the eggs. Look to the care of the incubator carefully and regularly, but do not change the regulator any more than is absolutely necessary. The eggs tend to throw



FIG. 2.—Incubator cellar at experimental farm of the Bureau of Animal Industry at Beltsville, Md., showing arrangement of incubators, man testing eggs, and thermometer for reading temperature of room.

off more heat as the embryo develops, so that it may be necessary occasionally to change the regulator slightly. The temperature of the egg chamber may be regulated by lowering the flame of the lamp in the middle of the day where the room is subject to a considerable rise in temperature. The machine should receive care enough so that the temperature remains nearly even. Most operators tend to their incubators two or three times daily, and occasionally make extra trips as conditions require them. Incubators require careful and regular attention, which, though simple, is very exacting. If attended to regularly incubators do not take much time, while neglect will generally show its effects on the hatch.

**THE CORRECT TEMPERATURE.**

The correct temperature depends upon the position of the thermometer in the egg chamber. The manufacturer's directions should be followed and changed only after considerable experience indicates that they can be improved. The need of this change may be due to the fact that a manufacturer can not make a machine and rules which will be adapted to all conditions. When the bulb of the thermometer rests directly on the eggs the temperature is usually held at  $101\frac{1}{2}^{\circ}$  to  $102^{\circ}$  F. the first week,  $102^{\circ}$  to  $103^{\circ}$  F. the second week, and  $103^{\circ}$  F. the third week; while a hanging thermometer is operated at about  $102^{\circ}$  to  $102\frac{1}{2}^{\circ}$  F. the first two weeks and  $103^{\circ}$  F. the last week. At hatching time the machine will frequently run up to  $104^{\circ}$  or  $105^{\circ}$  F. without any injury to the chickens. If the temperature has been right up to hatching time, it is usually better not to change the regulator at that time, provided the temperature does not run up above  $105^{\circ}$  F. While the eggs will hatch just as well if the temperature is run slightly higher than noted above throughout the hatch, the chickens are apt to be weak and hard to raise. In a good hatch the eggs will start to pip on the evening of the nineteenth day, and most of the chickens will be out of the shell on the morning of the twenty-first day. If the hatch is much earlier or later than this it indicates that the conditions during incubation have not been right. A high temperature may hatch eggs too quickly and produce weak chickens, while a continuous low temperature throughout the hatch will delay it for several hours.

**CARE OF THE LAMP.**

Use good oil. Clean and fill the lamp once daily, trimming the wick by scraping the charred portion off with a knife or square-edged nail, or by cutting the wick with scissors. The burners should be kept free from dirt and thoroughly cleaned by boiling after each hatch. A new wick is a good investment for each hatch, thus eliminating any danger of the wick giving out. Turn the eggs before caring for the lamp, so that there will be no chance to get oil on the eggs. The flame is apt to increase in size after lighting, so that it is advisable to return about one-half an hour after tending to the lamp to see that the flame is all right.

**CARE OF MACHINE AT HATCHING TIME.**

After the eggs begin to hatch, leave the machine alone until the hatch is well over. Do not open the door to see how the eggs are hatching, as it allows the moisture to escape, which is very essential at this time. Keep the incubator dark at hatching time by covering the glass in the door with a cloth or burlap sack, so that the chicks

will not be attracted to the front of the machine by the light and become restless. When the chicks are all hatched, remove the egg tray and open the ventilators, according to the manufacturer's directions, and keep them in the incubator from 24 to 36 hours after the hatch is over before removing them to the brooders. If they are to be shipped a long distance away, so that they will be on the road two or three days, it is better to ship them as soon as the hatch is over and the chicks are thoroughly dry. Chicks which pip, but are unable to get out of the shell by their own efforts, rarely amount to much if helped out, although, if desired, when most of the eggs are hatched and the chicks dried off, so that they will not be injured by opening the incubator door, any which have pipped may be helped out by cracking the shell and placing them back on the egg tray.

#### TURNING AND COOLING THE EGGS.

Eggs should be turned and cooled according to the directions furnished with the incubator. The eggs are usually turned for the first time at the end of the second day of incubation and twice daily through the eighteenth or nineteenth day, or until the chicks commence to pip. After turning the eggs, reverse the egg trays end for end, and from one side of the machine to the other in two-tray incubators. Keep the incubator door closed while turning the eggs, unless the directions state that it should be left open. Various mechanical devices have been invented for turning the eggs in the incubator, but most poultrymen prefer to shuffle them with their hands, removing a few from the center of the tray and working the others toward that point, placing those which were taken out on the sides of the tray. Cracked eggs may be saved by putting court-plaster over the crack, but this is advisable only in instances where the eggs are very valuable. The length of time to cool eggs depends upon the temperature of the incubator room. A good general rule is to leave the eggs out of the incubator until they feel slightly cool to the hand, face, or eyelid. Cool once daily after the seventh and up to the nineteenth day. Place the trays of eggs on the top of the machine or on a table in such a position that they are not in a draft, and so that the tray does not project over the edge of its support, thereby allowing part of the eggs to cool much quicker than the rest.

#### MOISTURE AND VENTILATION.

Moisture and ventilation are closely related factors in incubation, the amount of each depending upon the other. The former is one of the uncertain factors, for as yet no very satisfactory rules have been evolved which will cover all conditions. Good hatches are secured both with and without using moisture, under apparently

similar conditions, while each operator generally works out by experience the best amount of moisture to use under his conditions. The moisture and ventilation should, with correct heat, produce a normal chick at the end of the incubation period. Too much moisture may prevent the normal evaporation necessary to allow enough space for the chicken to turn in the egg and break the shell, while too little moisture may cause the chicken to become dried and stick to the shell. Moisture is used extensively in hatching in the South, in high altitudes, and in places where the incubator is run in a dry room.

Many methods are used to supply moisture in incubators, such as sprinkling the eggs with warm water at about 100° F., or placing a pan of water, a receptacle containing moist sand, or a wet sponge below the egg tray. Another common method of supplying moisture is to sprinkle or soak the floor of the incubator room or to place a pail of water under the lamp. There is less danger of getting too much moisture in the incubator by this method than by putting moisture directly into the egg chamber. If a moisture tray or sponge have been added to a non-moisture machine, they should generally be taken out before the chicks pip. The question of moisture depends largely on the place where the incubator is located. If run in a room in a dwelling house, it is frequently necessary to add moisture even to nonmoisture machines, while such machines run in an ordinary cellar in the same building might not need extra moisture. When a large number of machines are operated in one room extra moisture is more necessary than if only a few are kept together, while more moisture must be supplied in a very dry than in a humid climate.

Figure 3 shows the comparative size of the air cell on the seventh, fourteenth, and nineteenth days of incubation. This air cell varies in size with the size of the egg, while the shape varies greatly in different eggs. Moisture on the glass door of the incubator during hatching time is the best indication of correct moisture conditions during incubation. A good way to learn the proper amount of evaporation during incubation is to set one or two hens when starting the incubator, and compare the size of the air cell in the eggs

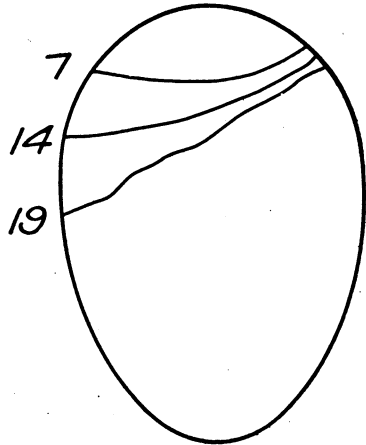


FIG. 3.—Diagram showing the air cell on the seventh, fourteenth, and nineteenth day of incubation.

under these two conditions when testing on the seventh and fourteenth days. As the weather becomes warmer more moisture is generally used than earlier in the season. Many operators add moisture only during the latter part of the hatch, generally on the sixteenth, seventeenth, and eighteenth days.

### TESTING EGGS.

An egg, whether impregnated or not, has a small grayish spot on the surface of the yolk known as the "germinal spot." As soon as a fertile egg is placed under a hen, or in an incubator, development begins. All eggs should be tested at least twice during the period of incubation, preferably on the seventh and fourteenth days, and the infertile eggs and dead germs removed. White eggs can be tested on the fourth or fifth day, while the development in eggs having brown shells often can not be seen by the use of an ordinary egg tester until the seventh day. Dead germs soon decay and give off a bad odor if allowed to remain in an incubator. Infertile eggs make good feed for young chickens, and are often used in the home for culinary purposes. Most incubator companies furnish testing chimneys with their machines which will fit the incubator lamps. Electric or gas lamps may be used in a box with a hole slightly smaller than an egg cut in the side of the box and at the same level as the light. They may also be tested by sunlight, or daylight, using a shutter or curtain with a small hole in it for the light to shine through.

A good homemade egg tester, or candler, can be made with a large shoe box, or any box that is large enough to go over a lamp, by removing the end and cutting a hole a little larger than the size of a quarter in the bottom of the box, so that when it is set over a kerosene lamp the hole in the bottom will be opposite the blaze. A hole the size of a silver dollar should be cut in the top of the box to allow the heat to escape.

The eggs are tested with the large end up, so that the size of the air cell may be seen as well as the condition of the embryo. The testing should take place in a dark room. The infertile egg when held before the small hole with the lamp lighted inside the box will look perfectly clear, the same as a fresh one, while a fertile egg will show a small dark spot, known as the embryo, with a mass of little blood veins extending in all directions, if the embryo is living; if dead, and the egg has been incubated for at least 46 hours, the blood settles away from the embryo toward the edges of the yolk, forming in some cases an irregular circle of blood, known as a blood ring. Eggs vary in this respect, some showing only a streak of blood. All

infertile eggs should be removed at the first test. The eggs containing strong, living embryos are dark and well filled up on the fourteenth day, and show a clear, sharp, distinct line of demarcation between the air cell and the growing embryo, while dead germs show only partial development, and lack this clear, distinct outline.

#### CAUSES OF POOR HATCHES.

The cause of poor hatches is a much-discussed question, which depends on a great variety of circumstances. A poor hatch is more apt to be due to the condition of the eggs previous to hatching than to incubation, although improper handling of either factor will produce the same results. When eggs fail to hatch, see whether the breeding stock is kept under conditions which tend to produce strong, fertile germs in the eggs, if the eggs have been handled properly before incubation, and whether the conditions were right during incubation, as judged by the time of the hatch.

A daily temperature record should be kept of each machine. The operator can thus compare the temperature at which the machines have been kept, which may prove of value in the future work, especially if the brooder records can be checked back against those of the incubator.

#### DISINFECTING AND STORING INCUBATORS.

After the hatching season is over, clean and disinfect the incubators, empty the lamps, and carefully store the parts in the machine. Lamps containing oil which are left in their proper place on the incubator for some time after the hatching season is over will cause trouble when it is started again, as the oil tends to work up into the hood. The incubator should be disinfected once a year, or oftener if any disease is present in the hens or chickens. Some operators prefer to disinfect their incubators before or after each hatch. A strong solution of a reliable coal-tar disinfectant may be used to wash out the machine and to disinfect the egg trays and nursery drawer. If the burlap on the bottom of the incubator is very dirty it may be cheaper to renew than to clean it. For an incubator of about 3 cubic feet capacity one may pour one-half ounce of formalin, which contains 40 per cent formaldehyde, on one-half ounce of permanganate of potash, in a pan in the incubator, which produces a very penetrating gas and thoroughly disinfects the machine. The door of the incubator should be closed just as soon as the liquid is poured into the pan, and left closed for 12 hours or longer. Incubators should be well aired before they are used after disinfecting, especially when formaldehyde or any disinfectant which produces a gas has been used.



**SUMMARY.**

Follow the manufacturer's directions in setting up and operating an incubator.

See that the incubator is running steadily at the desired temperature before filling with eggs. Do not add fresh eggs to a tray containing eggs which are undergoing incubation.

Turn the eggs twice daily after the second and until the nineteenth day. Cool the eggs once daily, according to the weather, from the seventh to the nineteenth day.

Turn the eggs before caring for the lamps.

Attend to the machine carefully at regular hours.

Keep the lamp and wick clean.

Test the eggs on the seventh and fourteenth days.

Do not open the machine after the eighteenth day until the chickens are hatched.

